

**National Transportation Safety Board  
Office of Marine Safety  
490 L'Enfant Plaza  
Washington D.C. 20594**

**Collision between the USS Greenville and the M/V Ehime Maru  
Off Honolulu, HI, on February 9, 2001**

**DCA 01 MM 022**

**Vessel Damage Factual Report**

**6/28/2002**

**Group Chairman:** Ash Chatterjee  
Office of Marine Safety, NTSB Hq,  
490 L'Enfant Plaza  
Washington, DC 20594

Phone (202) 314-6492  
Email: [chattea@ntsb.gov](mailto:chattea@ntsb.gov)

Other Group Members: None

### **Table of Contents**

1. Accident Summary
2. Vessel Information – M/V Ehime Maru
3. Hull Structure of the Ehime Maru
4. Damage Survey – Ehime Maru
5. Vessel Information – USS Greenville
6. Damage Survey – USS Greenville
7. Salvage Operations
8. References
9. List of Attachments

## **1. ACCIDENT SUMMARY**

While surfacing about 1343 (local time), the submarine USS Greeneville collided with the fisheries training vessel Ehime Maru. The Ehime Maru sank 6 minutes after the collision. Of the 35 crewmen, 26 successfully abandoned ship and entered liferafts. Coast Guard boats recovered the survivors about 1 hour after the collision. Bodies of eight of the nine missing personnel were recovered during salvage operations in October 2001. One student remains missing.

## **2. Vessel Information – M/V Ehime Maru**

A photo of the M/V Ehime Maru and its General Arrangement – Profile and Deck Plans are attached for reference and in the docket.

Length Overall (LOA): 58.18 m (190.9 ft)

Length Between Perpendiculars (LBP): 50.00 m (164.0 ft)

Breadth: 9.3 m (30.5 ft)

Draft: 3.5 m (11.5 ft)

Main Engine: 1800 HP (metric), 450 rpm, Model E28BFD

Reduction gear drive: 450/215 rpm

Propeller: 4 blades, Controllable Pitch, 9.5 ft diameter

Speed: 12.5 knots (cruise)

Main Generator: 500 KVA, 450 v AC, Model: TWY38CS6S

Tonnage: 499 GT

Max. Complement: 67 total (20 crew, 45 students, 2 instructors)

Actual onboard: 35 total (20 crew, 13 students, 2 instructors)

Lightship: 754 tonnes

Built: June 1996, Shin Kurushima Dockyard, Japan

Flag: Japan

Service: Fisheries Training Vessel

Owner: Ehime Prefecture

Operator: Uwa Jima Fisheries High School

### **3. Hull Structure of the Ehime Maru**

The hull bottom plating is ½ inch (12 mm) thick, and the innerbottom, located 4'-7" (1400 mm) above the bottom shell, is 9/32 in (7 mm) thick. Both inner and outer bottoms are longitudinally framed. The bilge keel extends from frame 58 at the bow to frame 27 at the stern. The vessel has a bar keel that is 2-1/3 inches (60 mm) thick and extends 9.5 inches (240 mm) below the bottom shell of the vessel.

The shell plating is 0.4133 in (10.5 mm) thick and is transversely framed with a spacing of 550 mm. The corridors alongside the deckhouse are 5'-9" wide. The main deck is 6 mm thick (except for the sheer strake at 8 mm) and is discontinuous between the housefront and the forecastle deck (ie between frames 59 and 80). The discontinuity is bridged by a fore and aft walkway on the port side.

### **4. Ehime Maru- Damage Survey**

Damage to the Ehime Maru (EM) was observed through underwater cameras mounted on a remotely operated vehicle (ROV), called the Scorpio. When remote cameras discovered the EM, it was sitting upright on the silty ocean floor with the vessel's bottom below the silt line. The EM had sunk in water depth of about 2,000 feet.

The vessel's side shell had buckled in a vertical line from the main deck down both its port and starboard sides; the buckling had occurred between the housefront and the forecastle where the Main deck was discontinuous, between frames 59 and 80 (see Sketch of above-water hull damage of Ehime Maru). There were ripples and cracks in the shell plating on port and starboard sides, adjacent to the vertical line of buckling. The walkway on the port side spanning the discontinuity in the Main deck had collapsed onto the deck below. The foremast had tilted to port and forward. The vessel's forward section had bent upwards from the keel. The bulbous bow was undamaged.

The underside of the stern above and aft of the rudder had been set in. There were ripples in the side shell plating, both port and starboard, in the aft part of the engineroom. Fishing nets and ropes were found hanging from the vessel.

A underwater survey of the vessel's bottom was later conducted by the US Navy using cameras mounted on a ROV, when the EM was raised off the sea bed for transportation to shallow water. The survey revealed a cut in the hull that began on the starboard side inboard of the bilge keel on the flat of bottom at frame 54 (near the deckhouse front). The cut, between 2 to 3 feet wide, ended on the port side shell at frame 21 in the vessel's engine room, where it extended vertically from the vessel's bottom to 11.5 feet (3.5 m) above it (the design waterline mark). At frame 21 the jagged edges of hull plating pointed outboard to port.

After the EM was transported to shallow water and set down on the ocean floor, divers for the Japanese authorities entered the interior of the vessel to search for bodies and record the damage on videotapes. Videos of the vessel's interior showed that, as the cut proceeded from forward to aft of the vessel, it had breached the vessel's innerbottom in the Students Mess, the Stairwell and the Engine Control room. The cut then proceeded through the bulkhead between the control room and the engine room, leaving a vertical cutout in the bulkhead, in the approximate shape and size of the Greenville's upper rudder. The vertical outline of the rudder was also clearly visible on the port side shell of the EM's engine room, through which the submarine's upper rudder had exited the EM's hull. The line of cut had also breached several double bottom (DB) tanks; going forward to aft these tanks included No.2 Fuel oil DB tank (Starboard), No. 3 Fuel oil DB tanks (Starboard and Center) and No.4 Fuel oil DB tank (Port) in the engine room.

The sandy bottom was clearly visible on camera from inside the vessel establishing that both outer and innerbottoms had been cut through. Damage to the control room was evidenced on tape by pictures of control panels, desks, chairs, telephones and acoustic insulation panels. Damage to the interior of the students mess and vertical stairtower on the port side of the Computer (CPU) room was also visible on tape. The open vertical stairtower would allow water to immediately flood upwards to the upper deck levels in the vessel.

## **5. Vessel Information - USS Greeneville**

Class: SSN 772, referred to as the 688 I (improved) “Arctic Capable” class

LOA: 362 ft (109.8 m)

Beam (hull diameter): 33 ft (10.1 m)

Displacement, tons: 6,330 tons surfaced; 7,177 tons submerged

Crew (nominal): 133, 13 officers

Speed: 25 knots +, dived

Diving Depth: 800 feet

Hull made of HY-80 steel, 3 inches thick plate outer hull

Bow is made of GRP fairing over spherical sonar array

The SSN 772 has bow mounted diving planes.

## **6. Damage Survey – USS Greeneville**

Safety Board investigators conducted a damage survey of the USS Greeneville in drydock at Pearl Harbor Naval Shipyard. Investigators found that the sail of the submarine showed no damage. Immediately below the sail, the acoustic hull surface treatment (tiles) on the portside hull had been sheared off in an elliptical pattern (see Photo 1 Hull Scrapes). The ellipse was about 24 feet long, starting 2 feet below the waterline at frame 50 and extending to frame 58. Going forward to aft the ellipse was inclined upwards at 20 degrees to the horizontal. The upper boundary of the ellipse showed a clean cut while the lower edge was jagged.

The upper rudder, located at the submarine’s stern, showed the greatest impact damage (Photo Damage to Leading Edge of Upper Rudder). Damage began at the 31 foot draft mark and extended all the way to the top of the upper rudder on both its port and starboard sides (Photos of Damage to Port and Starboard Sides of Upper Rudder). Surface tiles had been sheared off exposing bare metal over most of the rudder surface and there were several indentations on the rudder’s leading edge. One of the larger indentations had punctured the metal skin on the port side. The anchor light had been sheared off the top of the rudder. Surface tiles on the hull had been partially torn immediately to starboard of the trailing edge of the upper rudder. Other scrapes and

missing paint seen on the hull were correlated by the US Navy to previously existing wear and tear on the ship. The propeller area had not been damaged.

According to the US Navy the cost of labor and materials to repair the damage to the USS Geeneville totaled \$1,443,783.

## **7. Salvage Operations**

The US Navy's remotely operated vessel (ROV) Scorpio<sup>1</sup> was deployed from the dynamically positioned vessel C-Commando to locate the EM on the ocean bottom. The first attempt to locate the EM was aborted due to bad weather on February 14, 2001. On the second attempt, the EM was found through cameras mounted on the ROV, at 11:29 pm Friday, Feb 16, 2001 at latitude 21-04.95 N, longitude 157-49.58 W. The EM was found resting upright on a flat, sandy bottom and visibility through the cameras was good (about 50 feet). The debris field was not extensive; a few items were seen on the ocean bottom in the vicinity of the hull, such as personal effects of the EM crew including clothes, shoes, gloves, a bag, lifeboat canisters and submarine hull tiles. To augment the search for bodies the Navy Supervisor of Salvage later dispatched another ROV "Deep Drone" and a side scan sonar aboard the USNS Salvor.

Once the EM was discovered on the ocean bottom, the ROV cameras started the search for bodies and belongings at the stern of the EM and moved along the starboard side of the EM to its bow. The ROV then returned along the port side to the EM's stern, completing a counterclockwise circle. The cameras were moved up and down the ship's side as the ROV circled. The Scorpio was carefully maneuvered around the EM to avoid damage from guide wires, ropes, nets and vessel structure. The ROV could not be maneuvered inside the EM through small openings such as partially open doors or windows on the EM. Despite the good visibility, camera searches around the vessel found no remains of human bodies on or around the vessel.

At 1:30 am on October 12, 2001, the Navy and its contractors lifted the Ehime Maru off the ocean floor using a specially designed lifting and spreader assembly

---

<sup>1</sup> The ROV Scorpio belonged to the Navy's Deep Submergence Unit in San Diego, CA.

mounted aboard a Heavy Lift ship, the Rockwater 2, from its current 2,000 ft depth (see Diagram of Lift/ Spreader Assembly). The EM was transported while suspended 100 ft off the ocean floor, to a shallow water location. The location was roughly a mile south of Honolulu International Airport's Reef Runway, where the ocean bottom is about 115 feet deep. After the EM was lowered onto the ocean floor in shallow water, a team of US Navy and Japanese divers entered the EM to recover missing crewmember bodies, personal effects, mementos and recorded the vessel damage on videotape. After completing their search the EM was again transported to a site in the ocean about 16.5 miles from Reef Runway, where the Ehime Maru was lowered into its final resting place in water over 6,000 feet deep. (see diagram of vessel recovery location)

## **8. References:**

1. Two video tapes from survey of external hull damage of M/V Ehime Maru, during lift and relocation, US Navy
2. Video tape of Damage to Hull and Interior of M/V Ehime Maru, taken by divers from JDS Chihaya
3. General Arrangement Drawing for M/V Ehime Maru
4. Midship Section Structural Plan for Ehime Maru
5. E-mails concerning damage documentation
6. Damage Survey of USS Greeneville, US Navy memo dated 11 February 2001
7. Janes' Fighting Ships

## **9. List of Attachments**

1. E-photo of Ehime Maru
2. Scanned page of Ehime Maru General Arrangement & Deck Plans
3. Profile Sketch of Ehime Maru showing above water hull damage (source: USN)
4. Plan of Ehime Maru bottom showing line of hull cut
5. E-Mails concerning hull damage of Ehime Maru
6. 4 E-photos showing Hull Damage to USS Greeneville
  - i. Port hull damage
  - ii. Upper rudder – end view
  - iii. Upper rudder – port view



iv. Upper rudder – starboard view

7. Diagram of Vessel Lifting/ Spreader Assembly (source: USN)

8. Diagram of Vessel Recovery Location (source: USN)

愛媛県立宇和島水産高等学校水産実習船

# 之 び め 丸

EHIME - MARU



愛 媛 県 教 育 委 員 会

## 一般配置図

### GENERAL ARRANGEMENT えひめ丸

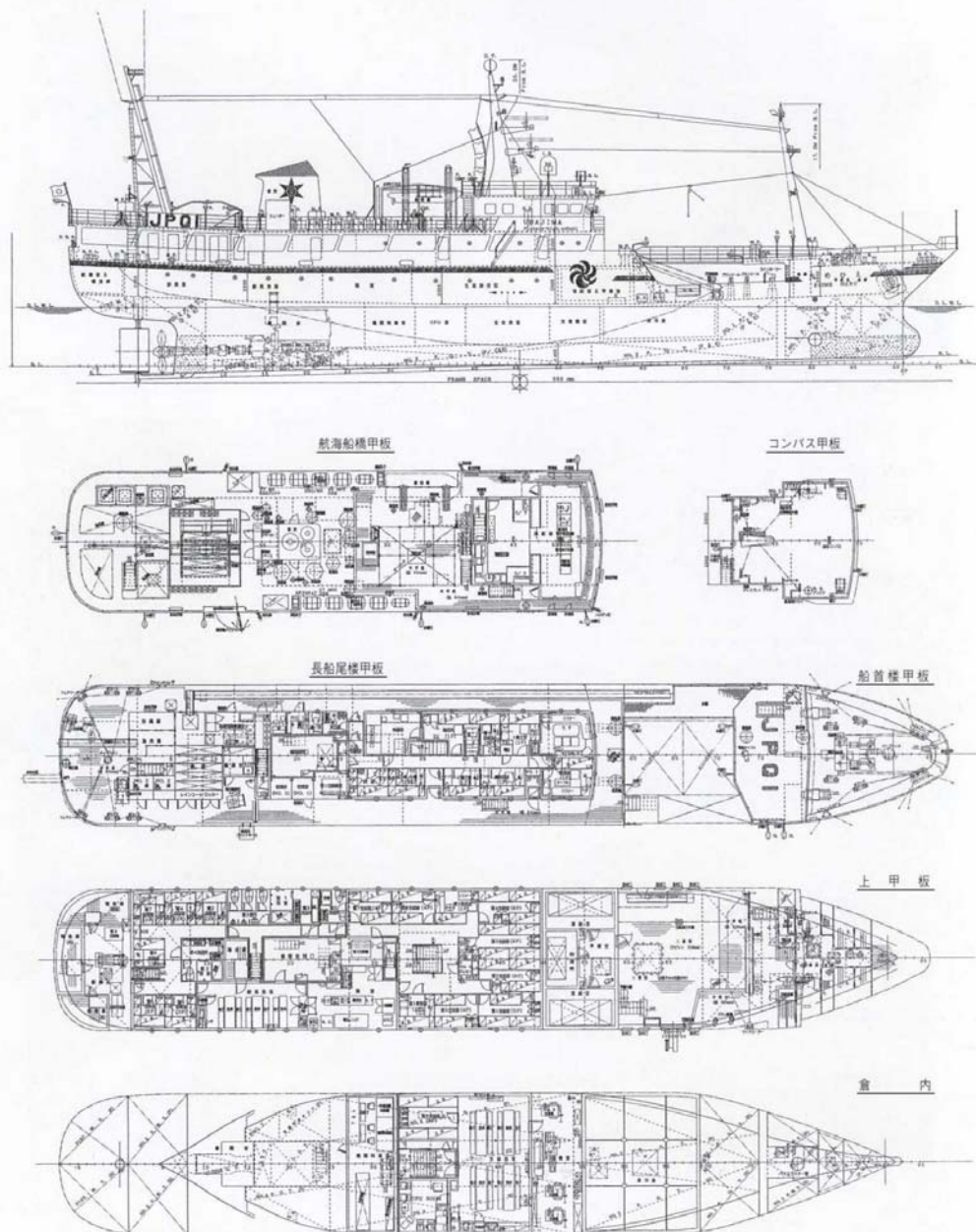
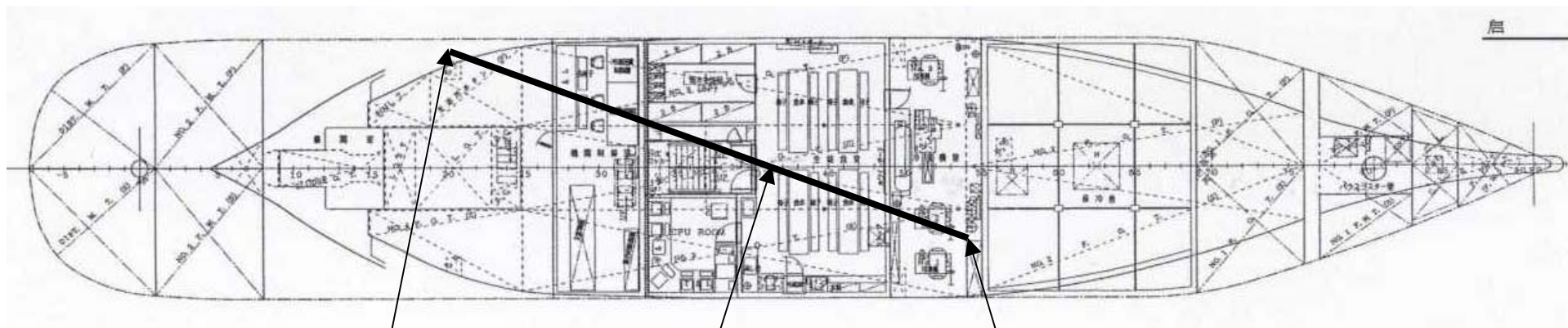


Figure Ehime Maru – General Arrangement & D4eck Plan





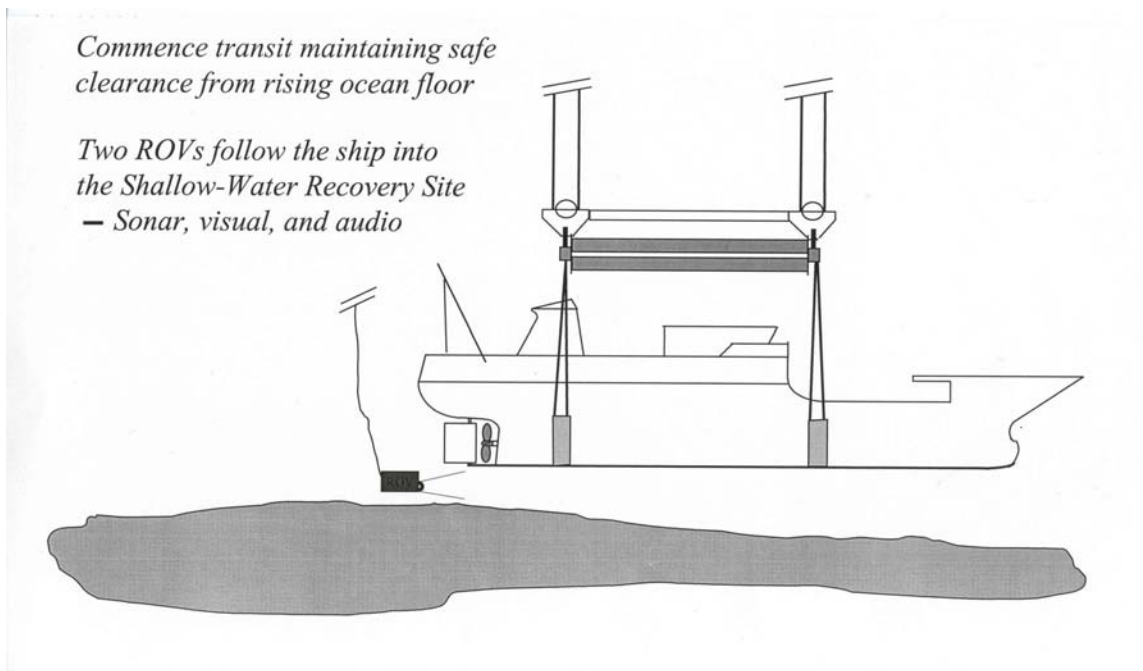


**Figure 1 - Line of cut in inner and outer bottom of Ehime Maru**

Frame 21

Line of cut

Frame 54



**Figure Ehime Maru Lifting/ Spreader Assembly**



**Figure USS Greenville – Damage to Port Hull**





**Figure** USS Greenville – Damage to Upper Rudder, view from leading edge





**Figure USS Greenville – Damage to Upper Rudder Portside**



**Figure USS Greenville – Damage to Upper Rudder Starboard Side**